AD-A191 618 DEFECTS IN HIGH-MOBILITY SEMICONDUCTOR SYSTEMS(U) LUND UNIV (SWEDEN) DEPT OF SOLID STATE PHYSICS H GRIMMEISS 23 OCT 87 DAJA45-87-C-0052 1/1

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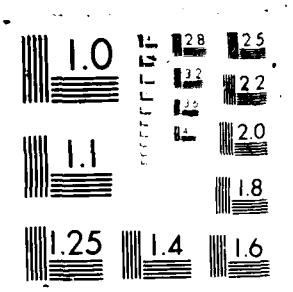
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First Interim Report

23 Oct 1987

DEFECTS IN HIGH-MOBILITY SEMICONDUCTOR SYSTEMS

Contract: DAJA45-87-C-0052 R&D Proposal: 5919-PH-01

Initial work under subject contract was devoted to (a) assembling and calibrating essential electrical, optical, and spectroscopic measurement facilities needed for analysis of defects in high-mobility structures; (b) application of such measurement systems to study of basic defects in previously characterized materials, in order to validate techniques and also to verify and extend our understanding of the physics of such basic defects; and (c) initiation of fabrication of critical test samples comprising heterostructures and superlatties of GaAs and Si or Ge.

(a) A new photocapacitance system was assembled and tested, using grating monochromator and supplementary filters.

(b) The P_b center in the 2-dimensional interface region of Si/SiO_2 structures was analyzed by photocapacitance, since this defect--perhaps the most important single point-defect in semiconductor technology--has well-established energy levels as a basis for calibration, yet has very unusual optoelectronic properties which have never been well diagnosed. Thus it very well meets the purposes of our initial research on high-mobility systems. The apparent and unusual very small optical transition cross-section or probability of this defect center were verified.

Initial EPR studies were devoted to the temperature dependence of the optical effect on the P_b signal, and to the perplexing problem of the lack of a normal EPR signal for Au in Si. The latter problem touches the very basic nature of dopant and/or conduction electrons in semiconductors, and may be related to the absence of an EPR signal from electrons in the inversion layer. The behavior of conduction electrons in regard to dopants, defects, and interfaces is one of the major goals of this research effort.

The apparent EPR signal from a 10-layer GaAs-AlAs superlattice was intensively examined, and finally proved to be from external or superficial sources, rather than intrinsic. This is an important and gratifying result, as a verified signal would have indicated either unwelcome impurities in the MBE fabrication process, or unusual new phenomena not concerned with the goals of the program---both of which might have delayed or confused the planned research.

(c) Several new heterostructures were designed and submitted to our fabrication facility for preparation. These included thick-layer AlAs on GaAs for preliminary doping defect studies; S and Se-implanted Si wafers; and simple heterostructures of GaAs. New structures will be devised based on EPR, photocapacitance, and DLTS results on these basic samples.

Hermann Grimmeiss
Principal Investigator
Department of Solid State Physics
University of Lund

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